

PATENT ABSTRACTS OF JAPAN

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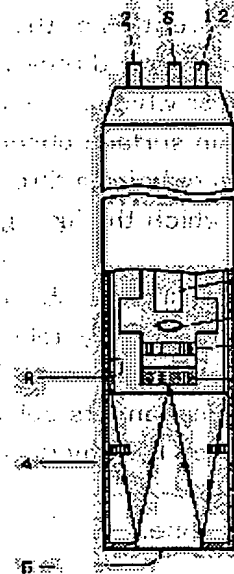
(72)Inventor : KOJIMA NOBUTOSHI
HOTTA HAJIME

(54) SKIN SURFACE OBSERVATION APPARATUS

(57)Abstract:

PURPOSE: To obtain a skin surface observation apparatus wherein the observation operation is simplified when a skin surface is observed by emitting independently a polarized light S and a polarized light P on the skin and on the reflected light from the skin to each emitted light, receiving also separately both a polarized light S component and a polarized light P component.

CONSTITUTION: A skin surface observation apparatus is provided with an emitting means for emitting a polarized light S or a polarized light P on the surface of a skin, a liq. crystal cell 10 wherein a reflected light of a light emitted on the skin from the emitting means is received and the polarization direction of the transmitted light is changed by applying an electric voltage, a polarized light filter 13 for receiving a transmitted light through the liq. crystal cell 10 and transmitting a polarized light S or a polarized light P and a photographing apparatus 14 receiving the polarized component transmitted through the polarized light filter 13.



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CLAIMS

[Claim(s)]

[Claim 1] The skin surface observation equipment carry out having image pick-up equipment which receives the reflected light of the light which carried out incidence to the skin from the exposure means to which a skin front face can make carry out the incidence of polarization S or the P polarization, and this exposure means, receives the light which penetrated the liquid crystal cell which changes the polarization direction of the transmitted light by impression of an electrical potential difference, and this liquid crystal cell, and receives the polarization component which penetrated the polarizing filter and this polarizing filter which make polarization S or polarization P penetrate as the description.

[Claim 2] Skin surface observation equipment according to claim 1 with which an exposure means consists of a polarizing filter for floodlighting which makes the cylindrical lighting system which injects the light by which the light guide was carried out from the light source, S polarization, or P polarization penetrate.

[Claim 3] Skin surface observation equipment according to claim 1 or 2 with which an exposure means consists of a liquid crystal cell which was prepared in the latter part of the cylindrical lighting system which injects the light by which the light guide was carried out from the light source; the polarizing filter for floodlighting, and its polarizing filter for floodlighting, and which changes the polarization direction of the transmitted light by impression of an electrical potential difference.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] Using the polarization property of light, this invention obtains separately surface reflected light images, such as a ripple of the skin, and pore, and the reflected light image inside the skins, such as a stain and a freckle, faces them carrying out analysis evaluation of the skin front face based on it, and relates to suitable skin surface observation equipment.

[0002]

[Description of the Prior Art] In order to make up foundation etc. to the skin and to obtain the desired

skin, the correspondence relation between the correspondence relation between the texture (or [that the skin is / how / visible to an observer / that is]) of the skin and the physical characteristic of the skin, the class of makeup, an amount, and the physical characteristic of the skin which gave makeup is analyzed, and it is effective to define the makeup which should be given to the skin concerned. Therefore, it is made by the approach of versatility [evaluate / the skin surface state of irregular colors, such as a stain inside conditions, such as a ripple on the front face of the skin, and pore or the skin, and a freckle, / from before / analyze and].

[0003] Although there is also a method of only carrying out photomacrography of the skin and analyzing a skin surface state on the basis of that image as an approach in this case, it cannot dissociate and this approach cannot estimate [can analyze skin surface states, such as a ripple and pore, and skin internal states, such as a stain and a freckle, and] them. Therefore, in order to analyze conditions, such as a ripple and pore, separately from irregular colors, such as a stain and a freckle, and to enable it to evaluate them, the method of using polarization is proposed (JP,2-206426,A etc.).

[0004] That is, as shown in drawing 7 , it is the natural light LI to Skin S. If incidence is carried out, the part is reflected on a skin front face (surface reflected light LS), and others will be refracted inside the skin, will repeat dispersion and absorption, and they will carry out outgoing radiation from a skin front face again (internal reflection LD). In this case, the surface reflected light LS has the information on the front face of the skin (concavo-convex information, refractive index), and is internal reflection LD. It has the information inside the skin (the color of the skin, irregular color). Moreover, the surface reflected light LS When the natural light LI which carried out incidence has predetermined plane of polarization, it is incident light LI. Although reflected as the linearly polarized light of the same plane of polarization, it is internal reflection LD. Polarizability was lost.

[0005] Then, in above-mentioned JP,2-206426,A, as shown in drawing 6 , the skin surface observation equipment which prepared the polarizing filter in the illuminating system and the light-receiving system inside equipment, respectively is used, and a skin front face is observed as follows. In the equipment of drawing 6 , it has the ring-like lighting system 3 which injects the light which carried out the light guide to the inner circle wall of the cylinder-like body 1 with the optical fiber 2 from the light source, and the polarizing filter 4 for floodlighting of the shape of a disk type which has the centrum of a concentric circle is formed in the front face of a tip of the ring-like lighting system 3. Moreover, the observation pore 5 has opened in the point of a body 1, the polarizing filter 6 for light-receiving is formed in the center near the tip of a body 1, and the expansion objective lens system 7 is formed behind this polarizing filter 6 for light-receiving. Furthermore, image pick-up equipment (not shown) is formed in the latter part of the expansion objective lens system 7, and the surface observation image received by image pick-up equipment is outputted to a monitor through a signal cable 8. And it is made, as for the polarizing filter 6 for light-receiving, for the polarization directions to differ to the polarizing filter 4 for floodlighting in this case. At the time of use of this equipment, first, the skin is made to contact the observation pore 5, polarization is irradiated through the polarizing filter 4 for floodlighting at the skin from the ring-like lighting system 3, that reflected light is received with image pick-up equipment through the polarizing filter 6 for light-receiving, and the image of the skin is formed. Thus, if a skin front face is observed, since the polarization directions of the polarizing filter 4 for floodlighting and the polarizing filter 6 for light-receiving differ, the light received with image pick-up equipment becomes that into which the direct reflected light on the front face of the skin was cut, and the image of the skin mainly comes to be formed based on internal reflection. Therefore, conditions, such as a stain and a freckle, come to be acquired more clearly than the case where the polarization direction of the polarizing filter 4 for floodlighting and the polarizing filter 6 for light-receiving is made the same.

[0006]

[Problem(s) to be Solved by the Invention] However, in the observation approach on the front face of the skin of having used the conventional polarization, since the image based on internal reflection was formed in above-mentioned JP,2-206426,A like the approach of a publication only based on the light of

the one polarization direction, there was a problem that the skin may be unable to be analyzed accurately and may be unable to be evaluated based on the image with which the image obtained was obtained unlike actual texture.

[0007] That is, the light used as the light source is usually the natural light. The natural light is unpolarized light, S polarization (polarization which has a plane of vibration perpendicular to plane of incidence), and P polarization (polarization which has a plane of vibration parallel to plane of incidence) are included by the same reinforcement, and an observer will receive the reflected light of these both sides, and will take in the texture of the skin. On the other hand, although the reflectivity of S polarization and P polarization differs greatly according to an incident angle, for example, S polarization shows a considerable reflection factor according to a specific incident angle, P polarization is not reflected at all. Therefore, the image and texture by which the image formed based on either S polarization or P polarization is actually observed will differ from each other.

[0008] On the other hand, this invention person used the both sides of S polarization and P polarization as a light which do incidence to the skin as an approach of observing a skin front face using polarization, and proposed the approach of receiving the reflected light to each incident light separately about the both sides of S polarization component and P polarization component (a Japanese-Patent-Application-No. No. 247523 [five to] specification, claim). According to this approach, the surface reflected light component and internal reflection component of the skin at the time of making the natural light into incident light can be computed, the surface-reflected light image and internal reflection image of the skin equal to actual texture can be obtained by this, and it becomes possible more about the description on the front face of the skin to carry out analysis evaluation at an eligibility.

[0009] However, in this approach, since two sorts of polarization is used as incident light to the skin and two sorts of polarization components are received about each of each incident light as the reflected light from the skin, it is necessary to obtain light-receiving data about the combination of a total of four kinds of incident light, and the reflected light. Therefore, when enforcing this approach with the conventional equipment shown in drawing 6 , whenever it obtains each light-receiving data, the polarizing filter for floodlighting or the polarizing filter for light-receiving must be changed, or mechanical actuation of changing the sense must be carried out. Therefore, there was a problem that observation actuation became very complicated.

[0010] As an approach of observing a skin front face so that this invention may solve the technical problem of such a conventional technique and surface reflected light images, such as a ripple on the front face of the skin and pore, and the reflected light image inside the skins, such as a stain and a freckle, can be obtained separately When carrying out incidence of S polarization and the P polarization to the skin separately and receiving S polarization component and P polarization component separately also as the reflected light from the skin to each incident light S polarization component and P polarization component of the reflected light to the incident light which has the one polarization direction Without carrying out mechanical actuation of a polarizing filter, it enables it to receive light, respectively and aims at offering the skin surface observation equipment which enables it to enforce the observation approach on such a front face of the skin simple.

[0011]

[Means for Solving the Problem] In receiving the reflected light at the time of making a skin front face carry out incidence of S polarization or the P polarization, this invention persons came to complete a header and this invention for the ability of the above-mentioned purpose to be attained, when the liquid crystal device which makes either the liquid crystal cell which changes the polarization direction of the transmitted light of a twist to impression of an electrical potential difference, S polarization component or P polarization component penetrate was used.

[0012] Namely, the exposure means to which this invention can make a skin front face carry out incidence of S polarization or the P polarization, The liquid crystal cell which receives the reflected light of the light which carried out incidence to the skin from this exposure means, and changes the

polarization direction of the transmitted light by impression of an electrical potential difference, The skin surface observation equipment characterized by having image pick-up equipment which receives the light which penetrated this liquid crystal cell, and receives the polarization component which penetrated the polarizing filter and this polarizing filter which make S polarization or P polarization penetrate is offered.

[0013]

[Function] In the skin surface observation equipment of this invention, the reflected light on the front face of the skin is first received by the liquid crystal cell which changes the polarization direction of the transmitted light by impression of an electrical potential difference, and the light which penetrated this liquid crystal cell is received with image pick-up equipment through a polarizing filter. therefore, when for example, TN cel is used and an electrical potential difference is impressed to a liquid crystal cell as this liquid crystal cell While S polarization component and P polarization component of the reflected light in the skin of the incident light (for example, incident light of S polarization) of the one polarization direction had maintained the original polarization direction, a liquid crystal cell is penetrated. Carry out incidence to a polarizing filter, a polarizing filter makes a predetermined polarization component (for example, S polarization component) penetrate, and the transmitted light is received with image pick-up equipment. Moreover, since the light which penetrated the liquid crystal cell changes the polarization direction in not impressing an electrical potential difference to a liquid crystal cell, S polarization component of the reflected light in the skin turns into P polarization component, a liquid crystal cell is penetrated, and P polarization component of the reflected light turns into S polarization component, and penetrates a liquid crystal cell, for example. After that, only a predetermined polarization component (for example, S polarization component) penetrates a polarizing filter, and the transmitted light is received with image pick-up equipment. Therefore, the light received with image pick-up equipment serves as a reflected light component (for example, P polarization component) which has the different polarization direction from the polarization component which penetrated the polarizing filter essentially.

[0014] Thus, according to the skin surface observation equipment of this invention, although image pick-up equipment will receive the light of the predetermined polarization direction (for example, S polarization) always specified with a polarizing filter, according to the existence of impression of the electrical potential difference to a liquid crystal cell, either S polarization component of the reflected light or P polarization component can receive it essentially. Therefore, S polarization component and P polarization component of the reflected light can be received simple only by being based on the existence of impression of the electrical potential difference to a liquid crystal cell, without carrying out mechanical actuation of a polarizing filter.

[0015] If the liquid crystal cell which changes the polarization direction of the transmitted light by impression of an electrical potential difference is prepared in the latter part of the cylindrical lighting system which injects the light by which the light guide was carried out from the light source as an exposure means to which incidence of S polarization or the P polarization can be carried out especially, the polarizing filter for floodlighting, and its polarizing filter for floodlighting, the polarization direction which carries out incidence to the skin by the existence of impression of an electrical potential difference is changeable. Therefore, it becomes completely unnecessary to use the both sides of S polarization and P polarization as incident light, to change a polarizing filter within equipment in performing the observation approach on the front face of the skin of receiving the reflected light to each incident light separately about the both sides of S polarization component and P polarization component, or to perform mechanical actuation of modification of the sense, and observation actuation becomes remarkably simple.

[0016]

[Example] Hereafter, the example of this invention is concretely explained based on a drawing. In addition, the same sign expresses the same or equivalent component among each drawing.

[0017] Drawing 1 is equipment I of one example of this invention. It is a partial notching sectional view

and drawing 2 is the general drawing of the system which performs skin surface observation using the equipment of drawing 1.

[0018] equipment I of drawing 1 **** — the ring-like lighting system 3 which injects the light which carried out the light guide to the inner circle wall of the cylinder-like body 1 with the optical fiber 2 from the light source 9 like the equipment shown in drawing 6 as an exposure means is formed. Moreover, the polarizing filter 4 for floodlighting of the shape of a disk type which has the centrum of a concentric circle is formed in the front face of a tip of the ring-like lighting system 3, and the observation pore 5 has opened in the point of a body 1.

[0019] The liquid crystal cell 10 is formed in the center near the tip of a body 1, and actuation of this liquid crystal cell 10 is controlled by the liquid crystal cell control section 11 through the cable 12 for control. As a liquid crystal cell 10, the thing which makes either S polarization component or P polarization component penetrate by impression of an electrical potential difference is prepared. As such a liquid crystal cell, TN cel etc. can be prepared, for example.

[0020] The polarizing filter 13 is formed in the latter part of a liquid crystal cell 10, and CCD camera 14 is further formed in the latter part as the expansion objective lens system 7 and image pick-up equipment. The picture signal from this CCD camera 14 is sent to the CCD camera control section 15 through a signal cable 8, and is further inputted into the image-processing section 16 of that latter part. This equipment I On the occasion of use, the skin surface observation approach indicated by the claim of an above-mentioned Japanese-Patent-Application-No. No. 247523 [five to] specification is followed, for example. When surface observation of the skin is performed by carrying out incidence of S polarization and the P polarization to the skin, respectively, and receiving the reflected light to each incident light separately about the both sides of S polarization component and P polarization component, First, according to any shall be irradiated between S polarization or P polarization, the polarizing filter 4 for floodlighting is suitably chosen as the skin to observe, and it sets to the predetermined sense. And the skin is made to contact the observation pore 5 and predetermined polarization (for example, P polarization) is irradiated through the polarizing filter 4 for floodlighting at the skin from the ring-like lighting system 3. Moreover, according to the polarization component which should receive light with CCD camera 14, the existence of impression of the predetermined electrical potential difference to a liquid crystal cell 10 is controlled by the liquid crystal cell control section 11.

[0021] For example, as shown in drawing 3, incidence of the P polarization is carried out to Skin S as a polarizing filter 4 for floodlighting using P polarizing plate. When P polarizing filter is used also as a polarizing filter 13 of the latter part of a liquid crystal cell and it is going to receive P polarization component of the reflected light from Skin S with CCD camera 14 A predetermined electrical potential difference is impressed to a liquid crystal cell (TN cel) 10, and it is made for the light which penetrated the liquid crystal cell 10 to have the same plane of polarization as the light which carried out incidence to the liquid crystal cell. Thereby, the reflected light in Skin S penetrates a liquid crystal cell 10, while S polarization component and P polarization component had also maintained the polarization direction, it carries out incidence to a polarizing filter 13, and only P polarization component penetrates a polarizing filter 13, and it comes to be received with CCD camera 14. When it is going to receive S polarization component of the reflected light from Skin S with CCD camera 14 in the same equipment configuration, impression of the electrical potential difference to a liquid crystal cell (TN cel) 10 is stopped, and it is made for the light which penetrated the liquid crystal cell 10 to, have different plane of polarization (for example, plane of polarization of the direction rotated 90 degrees) from the light which carried out incidence to the liquid crystal cell on the other hand, as shown in drawing 4. Thereby, S polarization component serves as P polarization after transparency of a liquid crystal cell 10 among the reflected lights in Skin S, and P polarization component serves as S polarization after transparency of a liquid crystal cell 10, and carries out incidence to a polarizing filter 13. And only P polarization (original S polarization component of the reflected light) penetrates a polarizing filter 13, and comes to be received with CCD camera 14. Thus, P polarization is irradiated at Skin S and it is S polarization component [of

the reflected light in that case] I (ps). P polarization component I (pp) Light-receiving data are obtained. [0022] Moreover, S polarization component [of the reflected light at the time of irradiating S polarization at the skin by repeating the above actuation, as the polarizing filter 4 for floodlighting serves as S polarizing plate] I (ss) P polarization component I (sp) Light-receiving data are also obtained. [0023] CCD camera 14 will input the picture signal into the image-processing section 16, if the light which penetrated the polarizing filter 13 is received. Four-sort light-receiving data I obtained in this way in the image-processing section 16 (ss) I (sp) I (ps) I (pp) It is based, and asks for on-the-strength [of the surface reflected light component at the time of carrying out incidence of the natural light to Skin S] I (S) by the formula (9)) of the degree type Japanese-Patent-Application-No. [(A) () No. 247523 [five to] specification, and a surface reflected light image is formed.

[0024]

[Equation 1]

$$I(S) = (I(pp) - I(ps)) + (I(ss) - I(sp)) (A)$$

Moreover, it asks for on-the-strength [of the internal reflection component at the time of carrying out incidence of the natural light to the skin] I (D) by the formula (10)) of the degree type Japanese-Patent-Application-No. [(B) () No. 247523 [five to] specification, and an internal reflection image is formed.

[0025]

[Equation 2]

$$I(D) = 2I(ps) + 2I(sp) (B)$$

The equipment II of drawing 5 is a modification at the time of constituting from a liquid crystal cell 17 which changes the polarization direction of the transmitted light by the cylindrical lighting system 3 which injects the light by which the light guide was carried out from the light source in the exposure means, the polarizing filter 4 for floodlighting, and impression of an electrical potential difference in the example of above-mentioned drawing 1. TN cel etc. can be used as such a liquid crystal cell. If TN cel is used as a liquid crystal cell 17 and the thing which makes S polarization or P polarization penetrate as a polarizing filter 4 for floodlighting is used in this exposure means, in not impressing an electrical potential difference to a liquid crystal cell 17, the polarization direction of the light irradiated by the skin will turn into the polarizing filter 4 for floodlighting, and a direction rotated 90 degrees, but if an electrical potential difference is impressed, it will become the same direction as the polarizing filter 4 for floodlighting. Therefore, even if it does not carry out mechanical actuation of changing the polarizing filter 4 for floodlighting for the skin according to whether S polarization is irradiated or P polarization is irradiated, or changing the sense, it becomes possible to irradiate both S polarization and P polarization to the skin by on of the applied voltage to a liquid crystal cell 16, and off. Therefore, incidence of S polarization and the P polarization is carried out to the skin, respectively, and it becomes possible by receiving the reflected light to each incident light about the both sides of S polarization component and P polarization component to perform observation actuation in the case of performing surface observation of the skin with a sufficient precision still simpler.

[0026] In addition, in the above example, although the case where the equipment of this invention was applied to the skin surface observation for obtaining separately surface reflected light images, such as a ripple on the front face of the skin and pore, and the reflected light image inside the skins, such as a stain and a freckle, was explained, the equipment of this invention is not restricted to this, but is applicable to surface observation of the various skins. Since it is especially easy to move an observed object, it is 4 sorts of light-receiving data I (ss). I (sp) I (ps) I (pp) It can be suitably used as observation equipment when it is difficult to measure according to an individual, for example, can be used as cameras for medical use, such as gastrocamera.

[0027]

[Effect of the Invention] According to this invention, incidence of S polarization and the P polarization is separately carried out to the skin, the both sides of S polarization component and P polarization

component are received also as the reflected light from the skin to each incident light, and it becomes possible to facilitate the observation actuation in the case of observing a skin front face so that a skin surface reflected light image and the reflected light image inside the skin can be obtained separately.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the partial notching sectional view of the equipment of one example of this invention.

[Drawing 2] It is the general drawing of the system which performs skin surface observation using the equipment of an example.

[Drawing 3] It is the explanatory view of an operation of the equipment of an example.

[Drawing 4] It is the explanatory view of an operation of the equipment of an example.

[Drawing 5] It is the partial notching sectional view of the equipment of other examples of this invention.

[Drawing 6] It is the partial notching sectional view of conventional skin surface observation equipment.

[Drawing 7] It is the explanatory view of surface reflection when the natural light carries out incidence to the skin, and internal reflection.

[Description of Notations]

1 Body

2 Optical Fiber

3 Ring-like Lighting System

4 Polarizing Filter for Floodlighting

5 Observation Pore

6 Polarizing Filter for Light-receiving

7 Objective Lens System

8 Signal Cable

9 Light Source

10 Liquid Crystal Cell

11 Liquid Crystal Cell Control Section

12 Cable for Control

13 Polarizing Filter

14 CCD Camera

15 CCD Camera Control Section

16 Image-Processing Section

17 Liquid Crystal Cell

I Equipment of an example

II Equipment of an example

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(71) 出願人 000000918

花王株式会社

東京都中央区日本橋茅場町1丁目14番10号

(72) 発明者 小島 伸俊

千葉県習志野市津田沼3-16-25-203

(72) 発明者 堀田 肇

埼玉県幸手市東4-21-5

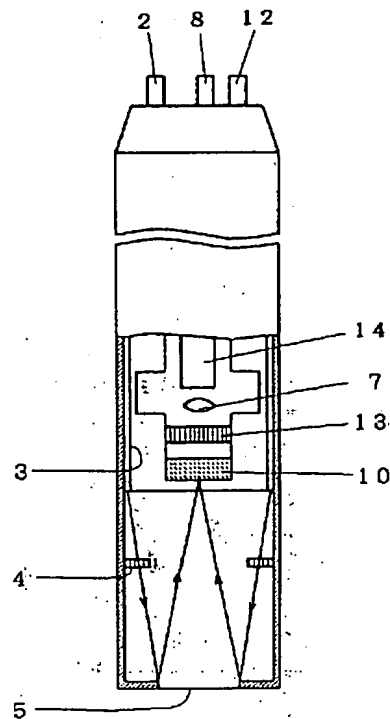
(74) 代理人 弁理士 田治米 登 (外1名)

(54) 【発明の名称】 皮膚表面観察装置

(57) 【要約】

【目的】 皮膚にS偏光とP偏光を別個に入射させ、各入射光に対する皮膚からの反射光もS偏光成分とP偏光成分の双方を別個に受光し、皮膚表面を観察する場合の観察操作を簡便化する皮膚表面観察装置を得る。

【構成】 皮膚表面観察装置が、皮膚表面にS偏光又はP偏光を入射させることのできる照射手段、該照射手段から皮膚に入射させた光の反射光を受光し、電圧の印加により透過光の偏光方向が変わる液晶セル10、該液晶セル10を透過した光を受光し、S偏光又はP偏光を透過させる偏光フィルター13、及び該偏光フィルター13を透過した偏光成分を受光する撮像装置14を有する。



【特許請求の範囲】

【請求項 1】 皮膚表面に S 偏光又は P 偏光を入射させることのできる照射手段、該照射手段から皮膚に入射させた光の反射光を受光し、電圧の印加により透過光の偏光方向が変わる液晶セル、該液晶セルを透過した光を受光し、S 偏光又は P 偏光を透過させる偏光フィルター及び該偏光フィルターを透過した偏光成分を受光する撮像装置を有することを特徴とする皮膚表面観察装置。

【請求項 2】 照射手段が、光源から導光された光を射出する円筒状照明装置と S 偏光又は P 偏光を透過させる投光用偏光フィルターからなる請求項 1 記載の皮膚表面観察装置。

【請求項 3】 照射手段が、光源から導光された光を射出する円筒状照明装置と、投光用偏光フィルターと、その投光用偏光フィルターの後段に設けられた、電圧の印加により透過光の偏光方向が変わる液晶セルからなる請求項 1 又は 2 に記載の皮膚表面観察装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、光の偏光特性を利用して、皮膚の小じわや毛穴等の表面反射光画像としみやそばかす等の皮膚内部の反射光画像とを別個に得、それに基づいて皮膚表面を解析評価するに際して好適な皮膚表面観察装置に関する。

【0002】

【従来の技術】肌にファンデーション等の化粧を施して所望の肌を得るためには、肌の質感（肌が観察者にどのように見えるかということ）と肌の物理的特性との対応関係や、化粧の種類や量と化粧を施した肌の物理的特性との対応関係を解析しておき、当該肌に施すべき化粧を定めることが有効である。そのため、従来より、皮膚表面の小じわや毛穴等の状態、あるいは皮膚内部のしみやそばかす等の色むらといった皮膚表面状態を解析し評価することが種々の方法でなされている。

【0003】この場合の方法としては、単に皮膚を拡大撮影し、その画像を基礎に皮膚表面状態を解析する方法もあるが、この方法では小じわや毛穴等の皮膚表面状態と、しみやそばかす等の皮膚内部状態とを分離して解析し評価することができない。そのため、小じわや毛穴等の状態をしみやそばかす等の色むらと別個に解析し評価できるようにするために、偏光を利用する方法が提案されている（特開平 2-206426 号公報等）。

【0004】即ち、図 7 に示すように、皮膚 S に自然光 LI が入射すると、その一部は皮膚表面で反射し（表面反射光 LS）、他は皮膚内部へ屈折し、散乱、吸収を繰り返して、再度皮膚表面から射出する（内部反射光 LD）。この場合、表面反射光 LS は皮膚表面の情報（凹凸情報、屈折率）をもち、内部反射光 LD は皮膚内部の情報（肌の色、色むら）を有する。また、表面反射光 LS は、入射した自然光 LI が所定の偏光面を有する場合

に、入射光 LI と同じ偏光面の直線偏光として反射されるが、内部反射光 LD は偏光性が失われたものとなる。

【0005】そこで、上述の特開平 2-206426 号公報においては、図 6 に示したように、装置内部の照射系と受光系にそれぞれ偏光フィルターを設けた皮膚表面観察装置を使用し、次のように皮膚表面を観察する。図 6 の装置においては、円筒状の本体 1 の内周壁に、光源から光ファイバー 2 により導光した光を射出するリング状照明装置 3 を有し、リング状照明装置 3 の先端前面には、同心円の中空部を有する円板形状の投光用偏光フィルター 4 が設けられている。また、本体 1 の先端部には観察孔部 5 が開けられており、本体 1 の先端近傍の中央には受光用偏光フィルター 6 が設けられており、この受光用偏光フィルター 6 の背後に拡大対物レンズ系 7 が設けられている。さらに拡大対物レンズ系 7 の後段に撮像装置（図示せず）が設けられ、撮像装置に受光された表面観察像が信号ケーブル 8 を通じてモニターに出力されるようになっている。そしてこの場合、受光用偏光フィルター 6 は投光用偏光フィルター 4 に対して偏光方向が異なるようにする。この装置の使用時には、まず、観察孔部 5 に皮膚を当接させ、リング状照明装置 3 から投光用偏光フィルター 4 を通じて皮膚に偏光を照射し、その反射光を受光用偏光フィルター 6 を通じて撮像装置で受光し、皮膚の画像を形成する。このように皮膚表面を観察すると、投光用偏光フィルター 4 と受光用偏光フィルター 6 の偏光方向が異なっているため、撮像装置で受光される光は皮膚表面での直接反射光がカットされたものとなり、皮膚の画像が主に内部反射光に基づいて形成されるようになる。したがって、しみやそばかす等の状態が、投光用偏光フィルター 4 と受光用偏光フィルター 6 の偏光方向を同一にした場合よりも明瞭に得られるようになる。

【0006】

【発明が解決しようとする課題】しかしながら、従来の偏光を利用した皮膚表面の観察方法においては、上述の特開平 2-206426 号公報に記載の方法のように、一つの偏光方向の光のみに基づいて内部反射光に基づく画像を形成するので、得られる画像が実際の質感と異なり、得られた画像に基づいて皮膚を適確に解析し評価することができない場合があるという問題があった。

【0007】即ち、通常、光源として用いられる光は自然光である。自然光は非偏光であり、S 偏光（入射面に垂直な振動面を有する偏光）と P 偏光（入射面に平行な振動面を有する偏光）とを同じ強度で含み、観察者はこれら双方の反射光を受光し、皮膚の質感を感じ取ることとなる。一方、S 偏光と P 偏光との反射強度は入射角に応じて大きく異なり、例えば、特定の入射角では S 偏光は相当の反射率を示すが P 偏光は全く反射されない。よって、S 偏光あるいは P 偏光の一方のみに基づいて形成した画像は実際に観察される画像と質感が異なることと

なる。

【0008】これに対して、本発明者は、偏光を使用して皮膚表面を観察する方法として、皮膚へ入射させる光としてS偏光とP偏光の双方を使用し、それぞれの入射光に対する反射光をS偏光成分とP偏光成分の双方について別個に受光する方法を提案した（特願平5-247523号明細書、特許請求の範囲）。この方法によれば、自然光を入射光とした場合の皮膚の表面反射光成分と内部反射光成分とを算出でき、これにより実際の質感と等しい皮膚の表面反射光画像と内部反射光画像とを得られ、皮膚表面の特徴をより適格に解析評価することが可能となる。

【0009】しかしながら、この方法においては、皮膚への入射光として2種の偏光を使用し、皮膚からの反射光として、各入射光のそれぞれについて2種の偏光成分を受光するので、合計4通りの入射光と反射光の組み合わせについて受光データを得ることが必要となる。そのため、図6に示した従来の装置でこの方法を実施する場合には、各受光データを得るたびに投光用偏光フィルター又は受光用偏光フィルターを付け替えるか向きを変えろといった機械的操作をしないでなければならない。よって、観察操作が非常に複雑となるという問題があった。

【0010】本発明はこのような従来技術の課題を解決しようとするものであり、皮膚表面の小じわや毛穴等の表面反射光画像としみやそばかす等の皮膚内部の反射光画像とを別個に得られるように皮膚表面を観察する方法として、皮膚にS偏光とP偏光を別個に入射させ、各入射光に対する皮膚からの反射光としてもS偏光成分とP偏光成分を別個に受光する場合に、一つの偏光方向を有する入射光に対する反射光のS偏光成分とP偏光成分とを、偏光フィルターの機械的操作をすることなく、それぞれ受光できるようにし、このような皮膚表面の観察方法を簡便に実施できるようにする皮膚表面観察装置を提供することを目的としている。

【0011】

【課題を解決するための手段】本発明者らは、皮膚表面にS偏光又はP偏光を入射させた場合の反射光を受光するにあたり、電圧の印加によりの透過光の偏光方向が変わる液晶セルとS偏光成分又はP偏光成分の一方を透過させる液晶素子を使用すると上述の目的を達成できることを見出し、本発明を完成させるに至った。

【0012】即ち、本発明は、皮膚表面にS偏光又はP偏光を入射させることのできる照射手段、該照射手段から皮膚に入射させた光の反射光を受光し、電圧の印加により透過光の偏光方向が変わる液晶セル、該液晶セルを透過した光を受光し、S偏光又はP偏光を透過させる偏光フィルター及び該偏光フィルターを透過した偏光成分を受光する撮像装置を有することを特徴とする皮膚表面観察装置を提供する。

【0013】

【作用】本発明の皮膚表面観察装置においては、皮膚表面での反射光を、まず、電圧の印加により透過光の偏光方向が変わる液晶セルで受光し、この液晶セルを透過した光を偏光フィルターを通して撮像装置で受光する。したがって、この液晶セルとして、例えばTNセルを使用し、液晶セルへ電圧を印加した場合には、一つの偏光方向の入射光（例えば、S偏光の入射光）の皮膚での反射光のS偏光成分とP偏光成分とが本来の偏光方向を維持したまま液晶セルを透過し、偏光フィルターに入射し、偏光フィルターが所定の偏光成分（例えば、S偏光成分）を透過させ、その透過光が撮像装置で受光される。また、液晶セルへ電圧を印加しない場合には、液晶セルを透過した光は偏光方向が変わるので、例えば、皮膚での反射光のS偏光成分はP偏光成分となって液晶セルを透過し、反射光のP偏光成分はS偏光成分となって液晶セルを透過する。その後は、偏光フィルターを所定の偏光成分（例えば、S偏光成分）のみが透過し、その透過光が撮像装置で受光される。したがって、撮像装置で受光される光は、本来的には偏光フィルターを透過した偏光成分と異なる偏光方向を有する反射光成分（例えば、P偏光成分）となる。

【0014】このように、本発明の皮膚表面観察装置によれば、撮像装置は、常に偏光フィルターで規定される所定の偏光方向（例えば、S偏光）の光を受光することとなるが、液晶セルへの電圧の印加の有無に応じて、本来的には反射光のS偏光成分又はP偏光成分のいずれも受光することができる。よって、反射光のS偏光成分とP偏光成分とを、偏光フィルターの機械的操作をすることなく、液晶セルへの電圧の印加の有無によるだけで、簡便に受光できるようになる。

【0015】特に、S偏光又はP偏光を入射させることのできる照射手段として、光源から導光された光を射出する円筒状照明装置と、投光用偏光フィルターと、その投光用偏光フィルターの後段に電圧の印加により透過光の偏光方向が変わる液晶セルとを設けると、電圧の印加の有無により皮膚に入射させる偏光方向を変えることができる。したがって、入射光としてS偏光とP偏光の双方を使用し、それぞれの入射光に対する反射光をS偏光成分とP偏光成分の双方について別個に受光するという皮膚表面の観察方法を行うにあたり、装置内で偏光フィルターを付け替えあるいは向きの変更といった機械的操作を行うことが全く不要となり、観察操作が著しく簡便になる。

【0016】

【実施例】以下、本発明の実施例を図面に基づいて具体的に説明する。なお、各図中、同一符号は同一又は同等の構成要素を表している。

【0017】図1は、本発明の一実施例の装置Iの部分切欠断面図であり、図2は、図1の装置を使用して皮膚表面観察を行うシステムの全体図である。

【0018】図1の装置Iには、照射手段として、図6に示した装置と同様に、円筒状の本体1の内周壁に、光源9から光ファイバー2により導光した光を射出するリング状照明装置3が設けられている。また、リング状照明装置3の先端前面には、同心円の中空部を有する円板形状の投光用偏光フィルター4が設けられており、本体1の先端部には観察孔部5が開けられている。

【0019】本体1の先端近傍の中央には液晶セル10が設けられており、この液晶セル10の動作は、液晶セル制御部11により制御用ケーブル12を通して制御される。液晶セル10としては、電圧の印加によりS偏光成分又はP偏光成分の一方を透過させるものを設ける。このような液晶セルとしては、例えば、TNセル等を設けることができる。

【0020】液晶セル10の後段には偏光フィルター13が設けられており、さらにその後段には、拡大対物レンズ系7、及び撮像装置としてCCDカメラ14が設けられている。このCCDカメラ14からの画像信号は、信号ケーブル8を通してCCDカメラ制御部15へ送られ、さらにその後段の画像処理部16に入力される。この装置Iの使用に際しては、例えば、上述の特願平5-247523号明細書の特許請求の範囲に記載されている皮膚表面観察方法にしたがって、皮膚へS偏光とP偏光をそれぞれ入射させ、それぞれの入射光に対する反射光をS偏光成分とP偏光成分の双方について別個に受光することにより皮膚の表面観察を行う場合、まず、観察する皮膚にS偏光又はP偏光のいずれを照射するかに応じて投光用偏光フィルター4を適宜選択し所定の向きにセットする。そして、観察孔部5に皮膚を当接させ、リング状照明装置3から投光用偏光フィルター4を通して皮膚に所定の偏光（例えば、P偏光）を照射する。また、CCDカメラ14で受光すべき偏光成分に応じ、液晶セル10への所定の電圧の印加の有無を液晶セル制御部11によって制御する。

【0021】例えば、図3に示したように、投光用偏光フィルター4としてP偏光板を使用して皮膚SにP偏光を入射させ、液晶セルの後段の偏光フィルター13とし*

$$I(S) = (I(pp) - I(ps)) + (I(ss) - I(sp)) \quad (A)$$

また、皮膚に自然光を入射させた場合の内部反射光成分の強度I(D)を、次式(B)（特願平5-247523号明細書の式(10)）により求め、内部反射光画像を形※

$$I(D) = 2 \cdot I(ps) + 2 \cdot I(sp) \quad (B)$$

図5の装置IIは、上述の図1の実施例において、照射手段を、光源から導光された光を射出する円筒状照明装置3と、投光用偏光フィルター4と、電圧の印加により透過光の偏光方向が変わる液晶セル17から構成した場合の変形例である。このような液晶セルとしては、TNセル等を使用することができる。この照射手段において、例えば、液晶セル17としてTNセルを使用し、投光用偏光フィルター4としてS偏光又はP偏光を透過させる

※てもP偏光フィルターを使用した場合に、CCDカメラ14で皮膚Sからの反射光のP偏光成分を受光しようとする場合には、液晶セル(TNセル)10へ所定の電圧を印加し、液晶セル10を透過した光が液晶セルへ入射した光と同一偏光面を有するようにする。これにより、皮膚Sでの反射光は、S偏光成分もP偏光成分もその偏光方向を維持したまま液晶セル10を透過して、偏光フィルター13に入射し、P偏光成分のみが偏光フィルター13を透過し、CCDカメラ14で受光されるようになる。一方、同様の装置構成においてCCDカメラ14で皮膚Sからの反射光のS偏光成分を受光しようとする場合には、図4に示したように、液晶セル(TNセル)10への電圧の印加を停止し、液晶セル10を透過した光が液晶セルへ入射した光と異なる偏光面（例えば90°回転した方向の偏光面）を有するようにする。これにより、皮膚Sでの反射光のうちS偏光成分は、液晶セル10の透過後にはP偏光となり、P偏光成分は、液晶セル10の透過後にはS偏光となって偏光フィルター13に入射する。そして、P偏光（反射光の本来のS偏光成分）のみが偏光フィルター13を透過し、CCDカメラ14で受光されるようになる。このようにして、皮膚SにP偏光を照射し、その場合の反射光のS偏光成分I(p s)とP偏光成分I(pp)の受光データを得る。

【0022】また、以上のような操作を、投光用偏光フィルター4がS偏光板となるようにして繰り返すことにより、皮膚にS偏光を照射した場合の反射光のS偏光成分I(ss)とP偏光成分I(sp)の受光データも得る。

【0023】CCDカメラ14は偏光フィルター13を透過した光を受光すると、その画像信号を画像処理部16に入力する。画像処理部16では、こうして得られた4種受光データI(ss)、I(sp)、I(ps)、I(pp)に基づき、皮膚Sに自然光を入射させた場合の表面反射光成分の強度I(S)を、次式(A)（特願平5-247523号明細書の式(9)）により求め、表面反射光画像を形成する。

【0024】

【数1】

※成する。

【0025】

【数2】

ものを使用すると、液晶セル17に電圧を印加しない場合には、皮膚に照射される光の偏光方向は投光用偏光フィルター4と90°回転した方向となるが、電圧を印加すると投光用偏光フィルター4と同一方向となる。したがって、皮膚にS偏光を照射するか又はP偏光を照射するかに応じて投光用偏光フィルター4を付け替えるかあるいは向きを変える等の機械的操作をしなくても、液晶セル16への印加電圧のon、offにより皮膚へS偏

光、P偏光のいずれも照射することが可能となる。よって、皮膚へS偏光とP偏光をそれぞれ入射させ、それぞれの入射光に対する反射光をS偏光成分とP偏光成分の双方について受光することにより皮膚の表面観察を行う場合の観察操作を、より一層簡便に、精度よく行うことが可能となる。

【0026】なお、以上の実施例においては、皮膚表面の小じわや毛穴等の表面反射光画像としみやそばかす等の皮膚内部の反射光画像とを別個に得るための皮膚表面観察に本発明の装置を適用する場合を説明したが、本発明の装置はこれに限られず種々の皮膚の表面観察に使用することができる。特に、被観察物が動きやすいため、4種の受光データI(ss)、I(sp)、I(ps)、I(pp)を個別に測定することが困難な場合の観察装置として好適に使用することができ、例えば胃カメラなどの医療用カメラとして使用することができる。

【0027】

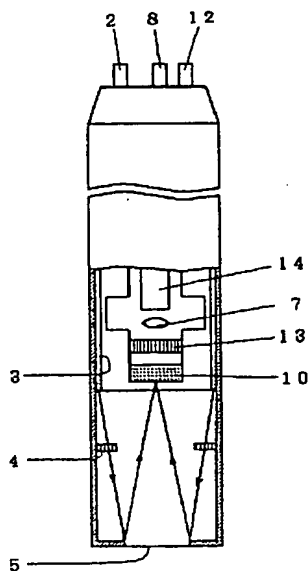
【発明の効果】本発明によれば、皮膚表面反射光画像と皮膚内部の反射光画像とを別個に得られるように、皮膚にS偏光とP偏光を別個に入射させ、各入射光に対する皮膚からの反射光としてもS偏光成分とP偏光成分の双方を受光し、皮膚表面を観察する場合の観察操作を簡便化することが可能となる。

【図面の簡単な説明】

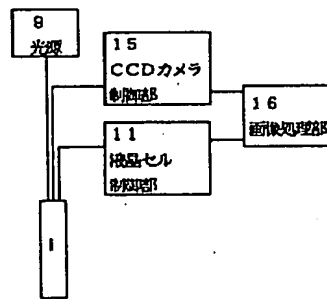
【図1】本発明の一実施例の装置の部分切欠断面図である。

【図2】実施例の装置を使用して皮膚表面観察を行うシステムの全体図である。

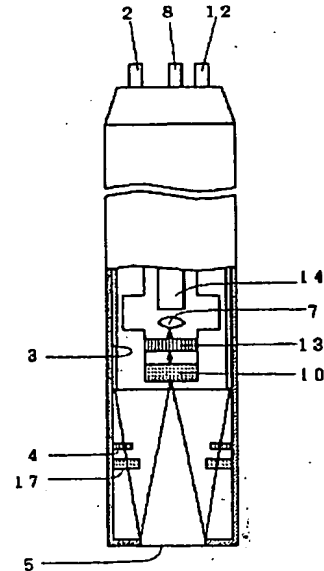
【図1】



【図2】



【図5】



【図3】実施例の装置の作用の説明図である。

【図4】実施例の装置の作用の説明図である。

【図5】本発明の他の実施例の装置の部分切欠断面図である。

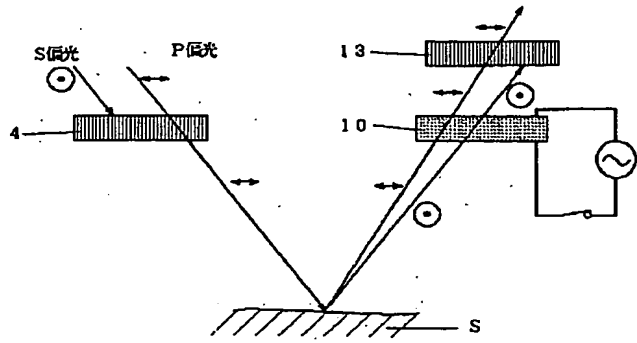
【図6】従来の皮膚表面観察装置の部分切欠断面図である。

【図7】皮膚に自然光が入射した場合の表面反射と内部反射の説明図である。

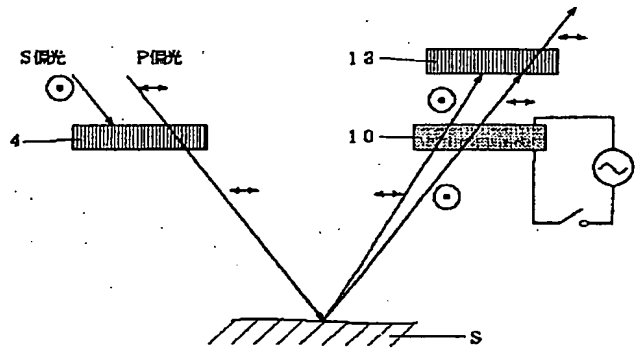
【符号の説明】

- | | |
|----|------------|
| 1 | 本体 |
| 2 | 光ファイバー |
| 3 | リング状照明装置 |
| 4 | 投光用偏光フィルター |
| 5 | 観察孔部 |
| 6 | 受光用偏光フィルター |
| 7 | 対物レンズ系 |
| 8 | 信号ケーブル |
| 9 | 光源 |
| 10 | 液晶セル |
| 11 | 液晶セル制御部 |
| 12 | 制御用ケーブル |
| 13 | 偏光フィルター |
| 14 | CCDカメラ |
| 15 | CCDカメラ制御部 |
| 16 | 画像処理部 |
| 17 | 液晶セル |
| I | 実施例の装置 |
| II | 実施例の装置 |

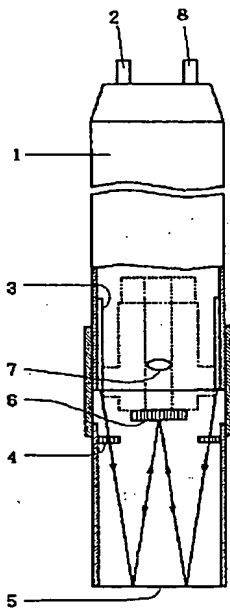
【図3】



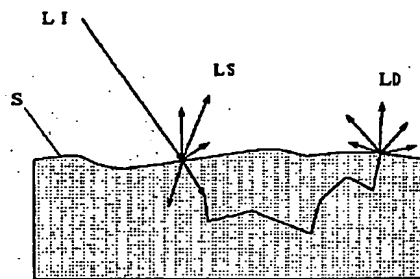
【図4】



【図6】



【図7】



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